In memoriam

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In memoriam Dr. Volker Magnus

Dr. Volker Magnus, an outstanding Croatian plant physiologist and member of the editorial board of this journal, passed away on July 30, 2009.

Volker was born March 22, 1942 in Eckernförde, Germany. He came to Zagreb as Deutscher Akademischer Austauschdienst (DAAD) fellow to study experimental biology at the Faculty of Natural Sciences and Mathematics, University of Zagreb, where he obtained a B.S. degree in 1967. Volker decided to continue his education in Zagreb, and as a graduate student began to carry out research in the Tracer Laboratory, Department of Organic Chemistry and Biochemistry at Ruđer Bošković Institute, under the supervision of Drs. Dina Keglević, Sonja Iskrić and Sergije Kveder, scientists interested in indole metabolism in biological systems. Volker's fascination with plants led him to choose indole metabolism in plants as his research topic. His MSc thesis, completed in 1971, dealt with the isolation of indole-3-methanol from pea seedlings, a metabolite of indole -3-acetic acid (IAA) (MAGNUS et al. 1971). His thesis marked the beginning of his life-long interest in plant hormone auxins. In his doctoral study, Volker isolated and synthesized a variety of tryptophol glycosides (MAGNUS et al. 1973, MAGNUS 1979), and obtained a Ph.D. in the field of plant biochemistry in 1976.

As one of his mentors and a long time colleague, I want to stress the many outstanding qualities of Volker Magnus: he was a very intelligent and gifted man, with a broad knowledge about plants and had a very good dexterity in organic synthesis. He was modest and self-effacing. Early in his career he became an independent scientist, proving himself in planning and running experiments and in writing papers. With time he became adept in helping colleagues around him with advice and in correction of their papers, making use of his excellent mastery of English, German and even Croatian. He left us much too soon.

Sonja Iskrić

Volker moved for postdoctoral training to Prof. Robert S. Bandurski's laboratory, Michigan State University, (Michigan, USA) in 1977. He worked on the development of a gas chromatography-mass spectrometry based isotope dilution assay for the plant hormone IAA. Combining his expertise in plant indoles with extensive knowledge of synthetic organic chemistry, he produced two stable deuterated forms of IAA (Fig. 1), thus enriching the auxin field with its first quantitative GC-MS isotope-dilution based assay (MAGNUS et al. 1980). His work provided the foundation stone for the development of quantitative measurements of auxin in plants.

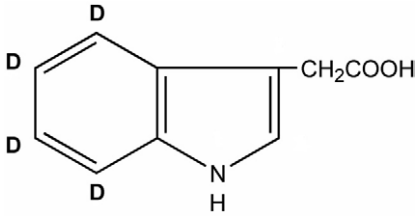

Fig. 1. Deuterated IAA with the labels on the ring (MAGNUS et al. 1980).

Upon completing his work on the first heavy isotope labeled IAA, he returned to the Ruđer Bošković Institute where he remained for the duration of his career. Beginning in 1979, Volker and his first Ph.D. student, Goran Laćan, continued doing research on Volker's »first love«: tryptophol and its glycosides. They synthesized a number of conjugate standards and identified endogenous glycosides in 120 different samples ranging from bacteria and fungi, to algae and plants (LAĆAN et al. 1984, LAĆAN et al. 1985). For that scientific achievement they obtained, in 1986, the »Award for Outstanding Research in Plant Physiology«, from the Glišić Foundation, University of Belgrade. In addition to auxin conjugates, Volker worked on alkyl and halogen auxins derivatives with his Ph.D. students, Nebojša Ilić and Eduard Dolušić, who later continued their careers abroad.

I met Volker in the late 1960s at the Ruđer Bošković Institute's Laboratory of Stereochemistry and Natural Products, where he worked part-time as a technician, and I was an organic chemistry novice in my junior year at the University of Zagreb. At a time when thousands of its citizens were emigrating to Germany in search of work, a soft-spoken German *Gastarbeiter* in Yugoslavia was an oddity. All of us who knew him then quickly recognized his keen sense of a language that was not native to him, as well as his meticulous approach to scientific endeavors. The willingness to learn from and selflessly share his knowledge with others was a lifelong trait. Volker was an excellent synthetic organic chemist for whom synthesis was not just a tool for probing plant physiology's unanswered questions, but also a challenge to which he responded with dedication and passion. As his first graduate student, I enjoyed his friendship and was given the chance to learn critical thinking and rigorous scrutiny crucial for scientific research. Volker's professional and personal legacy will always remind me of my dear friend, »the best plant physiologist among chemists and the best organic chemist among plant physiologists.«

Goran Laćan

Volker always maintained excellent contacts with colleagues abroad. He returned to Michigan State University in 1982, working for three years with Norman Good and Roger Hangarter on IAA-conjugates and their application in tissue cultures (MAGNUS et al. 1992a, b). In the period between 1991 and 1996 he took a scientific leave to work first in the Sandberg laboratory in Umea, Sweden, until 1993 (JAKAS et al. 1993, ILIĆ et al. 1997), and then moved to Mark Brenner's laboratory at the University of Minnesota, Minneapolis, MN, to work on 4-Cl-IAA in pea with Jocelyn Ozga and Dennis Reinecke (REINECKE et al. 1995, MAGNUS et al. 1997). Upon returning to the Ruđer Bošković Institute, in 2003, Volker founded the Laboratory of Chemical Biology, at the Department of Molecular Biology.

Volker was a scientist with interdisciplinary interests. As an excellent chemist and a passionate plant biologist, he collaborated with colleagues from divergent scientific fields. At his home institute, he collaborated for more than twenty years with Dr. Kojić-Prodić and her group (Biljana Nigović, Sanja Tomić, Snježana Antolić-Steiner and Branimir Bertoša) on the structure/activity relationship of auxins (Fig. 2). More than 50 indolic compounds were characterized structurally (most notably through use of X-ray diffraction, NMR and

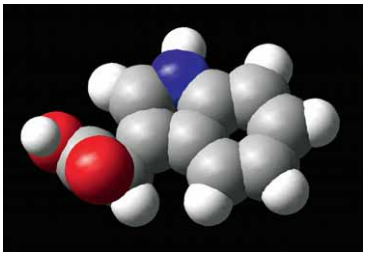

Fig. 2. 3D structure of indole-3-acetic acid (IAA) (KOJIĆ-PRODIĆ et al. 1999).

IR spectroscopy), and classified as active auxins, antagonists, or inactive compounds, based on different bioassays and modeling approaches. The collaboration resulted in more than 30 scientific papers, among which there were some representative ones on IAA amino acid conjugates (DUDDECK at al. 1989; KOJIĆ-PRODIĆ et al. 1991a, 1993, 1999), n-alkyl-substituted IAAs (ILIĆ et al.1991; KOJIĆ-PRODIĆ et al. 1991b; NIGOVIĆ et al. 1996, 2000; ANTOLIĆ et al. 2003), and halogen-substituted IAAs (ANTOLIĆ et al. 1996, 1999).These papers represent in the open literature the most comprehensive study of the 3-dimensional characterization of auxin and auxin-like molecules. Volker was also deeply involved in discussions on auxin binding protein (ABP1) and its role in the auxin signaling pathway (Fig. 3) (BERTOŠA et al. 2008.).

Volker was a silent and unobtrusive person, very analytical in thinking, and sometimes indecisive and cautious in reaching conclusions. Through the years, we successfully worked on many international projects funded by the US National Science Foundation, United States Department of Agriculture, the European Community, and in bilateral collaborative projects, producing more than 30 scientific papers, exhibiting with mutual respect and tolerance. Collaboration with Volker was fruitful, exhilarating, sometimes followed by surprises, an inseparable part of his personality.

Biserka Kojić-Prodić

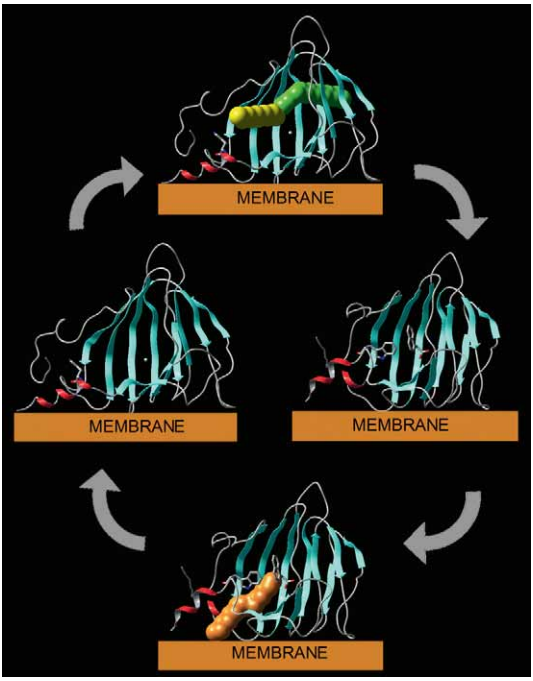

Fig. 3. Hypothesis on the mechanism of the auxin binding protein, ABP1, and its role in the auxin signaling pathway (BERTOŠA et al. 2008).

More recently, Volker's interests became focused on advanced methods for auxin localization, in the production of a novel class of antibodies based on linking ring-aminoalkyl substituted IAA to proteins (DOLUŠIĆ et al. 2001, ILIĆ et al. 2005, ŠOŠKIĆ and MAGNUS 2007, TOMAŠIĆ et al. 2007, ŠOŠKIĆ and MAGNUS, 2009), and the use of carbon nanotube microelectrodes to record the auxin flux (MANCUSO et al. 2005).

As a plant biologist, and that was how he primarily identified himself, he was interested in plant physiology and hormonal regulation of plant growth and developmental processes. He collaborated with Prof. Sibila Jelaska, Biology Department, Faculty of Science, University of Zagreb, in testing indole-3-ethanol and its sugar conjugates in the embryonic cultures of *Cucurbita pepo* (JELASKA et al. 1985). For more than twenty years they taught a joint course entitled: »Mechanisms of Plant Development«, at the doctoral study of biology at the Faculty of Science. Collaborating with his close friend and colleague from student days, Dr. Nikola Ljubešić, and later with Dr. Mercedes Wrischer, Volker was involved in research into plastids in different plant species. In a fruitful collaboration with the Laboratory of Electron Microscopy, he was involved in studies of the effect of growth substances on the greening process of non-green plastids (SALOPEK et al. 1998, 2000, 2002). Recently, he also took part in a collaborative study of ultrastructure and function of different types of plastids (WRISCHER et al. 1999, 2000, 2001, 2007, 2009).

Working with his Ph.D student Branka Salopek-Sondi during the last decade, he became actively involved in research on the role of plant hormones in the regulation of postanthesis development of the Christmas rose (*Helleborus niger* L.) flower. In this un-

usual plant, attractive flowers, white at anthesis, become intensively green upon fruit development, representing an excellent model for understanding cellular control of plastid development (Fig. 3) (SALOPEK-SONDI et al. 2000, 2002; SALOPEK-SONDI and MAGNUS 2007). In collaboration with colleagues from abroad, the hormones cytokinins, gibberellins, and auxins have been identified in this plant model and their role was discussed (TARKOWSKI et al. 2006, AYELE et al. 2009, PENČIK et al. 2009).

Volker was my mentor and teacher since 1993, when I started my scientific career at the Ruđer Bošković Institute. The enjoyable moments of our collaboration were field trips to the forests of Gorski kotar where we collected the flowers of the Christmas rose (*Helleborus niger* L.) for our research (Fig. 4). During our trips through

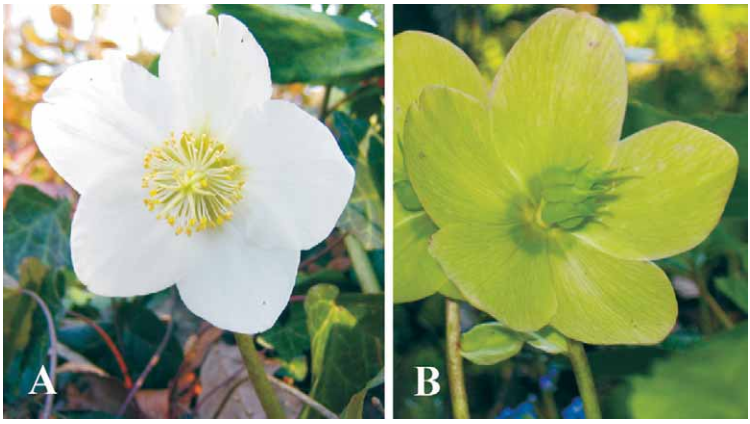

Fig. 4. The Christmas rose (*Helleborus niger* L.) flowers: white at anthesis (A), becoming green during fruit development (B).

the forest Volker was able to identify almost every plant along our way and had little stories about them, from either the biological or culinary aspects. Even more fascinating, he used to recognize birds hidden in the tree bushes based on their songs. Volker was a passionate naturalist, a very good botanist and a true plant lover. In the last few years, we shared an office and spent many afternoons in discussions over a cup of coffee. I will miss him.

Branka Salopek-Sondi

Auxin conjugates attracted Volker's attention during his entire scientific career. In the last few years, in collaboration with Prof. Jutta Ludwig-Müller from the Technical University of Dresden (Germany), he participated in research into the structure, function, and regulation of auxin amidohydrolases, enzymes that hydrolyze amino acid conjugates of auxin, releasing free active forms (Fig. 5.) (CAMPANELLA et al. 2004, SAVIĆ et al. 2009).

Volker was a member of the Croatian Society of Plant Biology (CSPB) for a long time, and its president from 1997 until 2001. He was the creator of the most recent Statutes of the Society and of the Society's representative emblem: the flower of *Aquilegia kitaibelii,* an

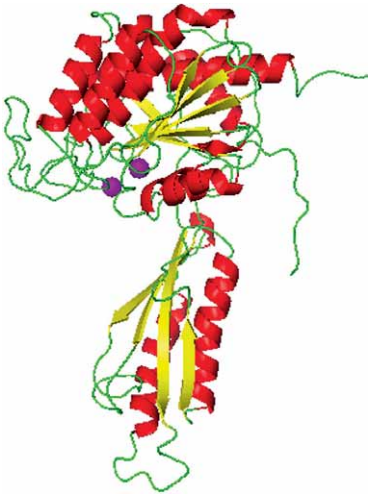

Fig. 5. Comparative model of auxin amidohydrolase from *Brassica rapa* L. with highlighted Mn^{2+} as a metal cofactor (violet spheres) (SAVIĆ et al. 2009).

Fig. 6. The flower of the Croatian endemic plant (*Aquilegia kitaibelii* Schot) (left) inspired Volker to create the emblem of the Croatian Society of Plant Biology (right). Photo of *Aquilegia* flowers is provided by professor Toni Nikolić from the Department of Botany, Division of Biology, Faculty of Science, University of Zagreb.

endemic Croatian plant residing in the mountains of Velebit and Plješivica (Fig. 5). It will always remind us of Volker, as well as Volker's famous bean soup, the one he used to cook for his friends and colleagues (the recipe for Volker's bean soup is posted on the CSPB web site: http://www.hdbb.hr). He was member of the editorial board of Acta Botanica Croatica from 1998 and was responsible for plant physiology and biochemistry.

Volker was entirely dedicated to science until the very end of his life. Although retired since 2008, he was in the laboratory daily, continuing his research, writing, and discussing problems with young colleagues. Volker Magnus came to Croatia and joined our scientific community silently; he lived and worked among us for more than 40 years, mostly unno-

ticed and silent, and left us, unexpectedly, in the same way. His work and scientific contributions to our and international science was anything but silent and unnoticed; it will remain priceless.

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